

**U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
OFFICE OF QUALITY ASSURANCE**

AUDIT REPORT LANL-ARP-99-01

OF

LOS ALAMOS NATIONAL LABORATORY

AT

LOS ALAMOS, NEW MEXICO

OCTOBER 19-22, 1998

Prepared by: _____ **Date:** _____

**Donald J. Harris
Audit Team Leader
Office of Quality Assurance**

Approved by: _____ **Date:** _____

**Robert W. Clark
Acting Director
Office of Quality Assurance**

1.0 EXECUTIVE SUMMARY

This performance-based Quality Assurance (QA) audit was conducted at Los Alamos National Laboratory (LANL), Los Alamos, New Mexico, October 19-22, 1998, to evaluate Milestone Report SP32E2M4SZ, *Reinterpretation of Reactive Tracer Test in Bullfrog Tuff and the Results of Laboratory Testing (C-Hole Update Report)*. The audit team determined that, with the exception of those areas where conditions adverse to quality were identified. LANL has effectively implemented the critical process steps for the preparation of this milestone report. In addition, the technical evaluation of the report determined that the scientific work was of good technical quality. Although the technical evaluation determined that the science was of good technical quality, the audit team concluded that the report should be revised to provide detailed quantification of the sensitivity and uncertainty factors (refer to Recommendations).

Three conditions adverse to quality were identified as a result of the audit. Unqualified C-Well Core was utilized in laboratory testing, DIFCEL unqualified software was utilized to perform interpretations of data, and completed Scientific Notebooks (SN) were not submitted to the Records Processing Center (RPC) after close out by the Principal Investigator (PI). Details of the conditions adverse to quality are presented in Section 5.5 of this report. The audit team also identified seven Recommendations during the audit which are detailed in Section 6.0 of this report.

2.0 SCOPE

The audit was conducted to evaluate the technical adequacy of the following LANL deliverable (milestone report) and the effectiveness of critical process steps implemented during the preparation of the deliverable:

- Work Breakdown Structure (WBS) 1.2.3.3.1.3.1, *Reactive Tracer Testing C-Wells, Milestone SP32E2M4SZ, Reinterpretation of Reactive Tracer Test in Bullfrog Tuff and Results of Laboratory Testing (C-Hole Update Report)*

The audit team conducted interviews and reviews of documentation in accordance with the approved Audit Plan to evaluate the adequacy of the deliverable and effectiveness of the critical process steps.

2.1 Process Steps/Products/Documentation

The performance-based evaluation was based upon the following:

1. Satisfactory completion of critical process steps.
2. Acceptable results and quality of the end product.
3. Documentation that substantiates the quality of products.

4. Performance of trained and qualified personnel.
5. Implementation of applicable QA program elements.

The following critical process steps were considered during the evaluation of Milestone Report SP32E2M4SZ:

1. Scientific Investigation Planning.
2. Identification, Traceability and Control of Data.
3. Data Analysis, Review and Interpretation.
4. Control of Software.
5. Model Development Code, Validation, Calibration and Output Reporting.
6. Independent Review of Study Results.
7. Data Input to Genesis.
8. Identification/Submittal of Cited References to the Technical Information Center (TIC).

2.2 Technical Areas

The audit included a technical evaluation of the adequacy of the milestone report. Details of the technical evaluation are documented in Section 5.4 of this report.

3.0 AUDIT TEAM AND OBSERVERS

Name/Title/Organization

- Donald J. Harris, Audit Team Leader, Office of Quality Assurance (OQA)
- Kenneth T. McFall, Auditor, OQA
- Keith Kersch, Technical Specialist, Civilian Radioactive Waste Management System Management and Operating Contractor (CRWMS M&O)
- Jeff Ciocco, Observer, U.S. Nuclear Regulatory Commission (NRC)
- Ted Carter, Observer, NRC
- Susan Zimmerman, Observer, State of Nevada

4.0 AUDIT TEAM MEETINGS AND PERSONNEL CONTACTED

A pre-audit meeting was conducted at LANL on October 19, 1998. Daily debriefings were held to apprise LANL management and staff of the progress of the audit and of any identified conditions adverse to quality. A post-audit meeting was conducted at LANL on October 22, 1998.

Personnel contacted during the audit, including those that attended the audit pre-conference and post-conference meetings, are listed in Attachment 1.

5.0 SUMMARY OF RESULTS

5.1 Program Effectiveness

With the exception of the areas where conditions adverse to quality were identified, the audit team concluded that critical process steps applicable to the preparation of milestone reports were effectively implemented.

5.2 Stop Work or Immediate Corrective Action Taken

There were no stop work actions or immediate corrective actions taken as a result of the audit.

5.3 QA Program Implementation

A summary table of audit results is provided in Attachment 2 and 3. Details of the audit, including the objective evidence reviewed, are documented in the audit checklist. The checklist is maintained as a QA record.

5.4 Technical Audit Activities

Based on interviews that were conducted during the audit, the PI, Paul W. Reimus, appeared to have a good grasp of the requirements to support the milestone report activities. LANL was very cooperative and helpful during the audit.

The audit team was first provided with a draft version of the milestone, dated September 3, 1998. At the beginning of the audit, the team was given the most recent (submitted) version of the report, dated September 15, 1998. The audit team preparation for this audit was based on the first version of the report. The audit preparation would have been more effective if the final version of the report had been provided earlier.

The audit team was unable to interview all the personnel who worked on the milestone because some of the personnel were at the Nevada Test Site; one was at New Mexico Tech located in Socorro, New Mexico; and one was on vacation. Consequently, the SNs in their possession were unavailable for review. However, as a result of Los Alamos Surveillance LANL-SR-98-40, a Deficiency Report

(DR) LANL-98-D-120 was initiated and dispositioned to require an annual technical review, identification of scoping activities, and correction of any inadequacies of SNs under the cognizance of Paul Reimus.

The work planning process has not been adequately defined for this activity. The controlling procedure, LANL YMP-QP-03.23 titled, *Preparation and Review of Technical Information Products and Study Plans*, still addresses Study Plans which were withdrawn (Reference LVMO-98-D-027). The Statement of Work (SOW) associated with this milestone contains four sentences in the Fiscal Year (FY)1998 SOW for planning; the PI utilized the SOW, withdrawn Study Plan, and the Field Work Package for C-Hole Complex Saturated Zone-Tracer Testing (FWP-SBT96-09, Revision 02). Additional planning was detailed in the SNs that were examined. Only through interviews with the PI and LANL staff could the audit team identify the specific planning documents, their applicability, and various locations of the planning documentation in the SNs. LANL staff. LANL Technical Assurance and the OQA Representative are currently developing a planning process which will require planning to be performed prior to the initiation of any work activity.

The audited Milestone Report SP32E2M4SZ supports WBS 1.2.3.3.1.3.1 Hydrologic Testing for License Application. The information developed is critical to the development of the Safety Case for the Yucca Mountain Project. This information included confirmation of the Conceptual Model for Sorption, Diffusion, and Dispersion of Solutes in the Saturated Zone, and determination of the coefficients of this model. It provides an update of the results and interpretation of the Reactive Tracer Test conducted in the Bullfrog Tuff at the C-Holes and all laboratory testing conducted to date in support of Reactive Tracer Testing at the C-Holes. The laboratory test refined the interpretations of the FY1997 Bullfrog Reactive Tracer Test as well as the test that supports the predictions/ interpretations of the Prow Pass Reactive Tracer Test scheduled for late FY1998.

The completed milestone is considered an interim report that supports a Level 3 Milestone (SP32E1M3) due early next year. The audit team determined that the science was technically adequate. However, it appeared that the PI pursued the science at the expense of the programmatic requirements. The three primary shortcomings of the milestone are: (1) Laboratory experiments were performed on unqualified core taken from C-Wells; (2) Some of the analytical interpretations were made using unqualified software (DIFCEL); and (3) The report only partially satisfied the requirements of the Natural Environment Program Operations (NEPO) guidance on implementing the "Interim Direction for Document Development" of July 15, 1998 (Reference 3 of Section 6.0).

This NEPO guidance document establishes the CRWMS M&O policy and NEPO expectations for planning, report preparation, review, and delivery of Level 3 and Level 4 Milestone Reports. Although the interim direction document is considered a positive step toward readiness for the licensing process, it should be

implemented only to the point that it does not conflict with project-level procedures. The CRWMS M&O needs to evaluate the interim direction for adequacy, consistency with YAP-5.8Q, and applicability to the Authorized Organizations. Furthermore, the interim direction should be incorporated into project-level procedures; e.g., YAP-5.8Q, to preclude any perception of a reduction in commitment relative to working to controlled implementing documents.

5.5 Summary of Conditions Adverse to Quality

The audit team identified three conditions adverse to quality during the audit. Corrective action for two conditions will be addressed in response to the OCRWM deficiency documents identified in Section 5.5.2 of this report. One condition adverse to quality was corrected during the course of the audit and is addressed in Section 5.5.4 of the report.

5.5.1 Corrective Action Request

None.

5.5.2 Deficiency Reports (DR)

DR LANL-99-D-006

Acquired and modified DIFCEL software was utilized to perform interpretation of data for the milestone report. The software has not been qualified and does not meet the requirements of the Quality Assurance Requirements and Description (QARD) document.

DR LANL-99-D-007

The milestone report contains Q data which may be relied upon to address safety and waste isolation issues. LANL derived laboratory test data from unqualified C-Well Core.

5.5.3 Performance Reports

None.

5.5.4 Conditions Adverse to Quality Corrected During the Audit (CDA)

SNs LA-EES-4-NBK-96-002(b), *Microspheres*, and LA-EES-4-NBK-96-003, *Reactive Tracer Testing*, had technical reviews completed on May 28, 1997, by Larry S. Hersman and a closure statement by the PI. No later

entries were in the SNs. They were sitting on the shelf and no copies had been submitted to the RPC. The SNs were processed through Technical Assurance Reviews and submitted to the RPC.

5.5.5 Follow-up of Previously Issued Deficiency Documents

Deficiency Report (DR) LVMO-98-D-027, Planning Scientific Investigations

This DR issued to the CRWMS M&O documented the lack of a procedure describing NEPO's quality planning process for scientific investigations and scientific investigations performed at USGS and LANL. The disposition of the DR required LANL to evaluate and revise (as necessary) LANL-YMP-QP-03.23. In addition, DR LANL-98-D-108 was dispositioned to require a revision to LANL-YMP-QP-03.23 to incorporate the requirements of NEPO's interim guidance (Reference 3 of Section 6.0).

Currently, as of the date of this audit, LANL-YMP-QP-03.23 has not been revised. It still addresses study plans that were withdrawn in June 1997 (Reference DR YM-97-D-032). Consequently, the planning process at LANL still has not been procedurally defined.

In discussions with LANL Technical Assurance and the OQA on site representative, the audit team was informed that LANL was in the process of drafting a planning procedure. The completion date for the procedure had not been determined as of the completion of this audit.

6.0 RECOMMENDATIONS

The following recommendations resulted from the audit and are presented for CRWMS M&O and LANL management consideration and require a formal response to OQA:

1. Strickler 1998 (Reference 2 of Section 6.0) specifies in Section 3.5 that all references in project documents should be in the Technical Data Management System and that references contain a data tracking number. Not all of the references in the milestone report had been submitted to the TIC. Some of the references did not have accession numbers listed. Other references are listed as "personal communications," and "unpublished reports," which cannot be verified by outside reviewers. All references should be available for outside reviewers through the project records system. It is recommended that the report be revised to comply with the Strickler direction.

2. Sensitivity and uncertainty are not well quantified in the milestone report. Users of the data will need to know the accuracy of the results. The audit team recommends that the milestone report be revised to include more detailed quantification of sensitivity and uncertainty. Some examples of the need for this quantification follow:
 - i. In the middle of page 4.1, there is a listing of an assumed value of grain density for central Bullfrog Tuff of 2.65. At the bottom of page 2.11 it lists a bulk density of 1.9 with porosity of 0.1 for this same interval. This corresponds to a grain density of 2.6. The project database lists even different values (see tracking number MO9708RIB00040.000). Grain density measurements have been made and some of these values are listed in project databases. The range of these measured values should be examined, and included in the report.
 - ii. The analyses of field transport in this report are based on the assumption that the flow path is a homogeneous, isotropic, continuum, yet it is known that the rock is anisotropic and non-homogeneous, with discrete flow paths. There is uncertainty in the assumed thickness of the flow paths that has a significant impact on the results of some of the analyses.
 - iii. The assumption is made that the Bullfrog Tuff is non-leaky (page 1.1 near the bottom) based on the work of Geldon. In the same paragraph the authors acknowledge that there were pressure responses in other intervals during flow tests. Determine how sensitive the results are to this assumption.
 - iv. At the bottom of page 2.26 it states that results "...were not very sensitive to fracture sorption parameters." This statement needs to be quantified.
 - v. The milestone report has a weakly developed, yet very important, conclusion that the dual-porosity model is valid for the Yucca Mountain saturated zone.
 - vi. The milestone report has rather loose discussion of "future work plans and activities" related to this WBS sub-element throughout the text. There were several places in the text, particularly in Chapter 2 (see p. 2-20 last paragraph and p. 2-21 last paragraph) where the authors described (not recommend) future tracer work they plan to do directly related to this milestone report. According to the PI, there will be no future work beyond 3/15/99 and the current Prow Pass tracer tests. Thus it is misleading to the reader that there will be more related work. Recommendations for follow-on activities should be consolidated and summarized in a chapter at the end of the report titled "Recommended Future Activities." Recommendations are commonplace in most technical reports and this format won't imply the work will actually be done, which it might not be.

3. Interface definition is needed for this milestone report. This milestone report contains the results of several analyses, interpretations, and laboratory measurements. It is not clear how these results will be used and who will be using them. It would improve the process if the user of the results could be identified and the form and format of the needed results specified in writing. A process similar to that specified in NLP 3.34 (Reference 1 of Section 6.0) below is recommended. In this process, the information developer and information user specify in writing what results are needed and the form of the results.
4. In some instances it appears that laboratory data were recorded initially on informal sheets and later transcribed onto official notebooks or spreadsheets. Data should be recorded directly into laboratory notebooks or data sheets that are captured by the records system.
5. Equation 5.2 contains a typographical error that should be corrected.
6. Expedite the development of the scientific planning procedure and either incorporate into the existing LANL-YMP-QP-03.23 or issue as a new quality procedure. In addition, QP-03.23 requires revision to remove all information related to the withdrawn study plan.
7. The NEPO interim direction (Reference 3 of Section 6.0) should be incorporated into LANL-YMP- QP-03.23 on an expedited basis. Until this occurs, all PIs should be directed in writing to implement its requirements on all future deliverables.

References

1. *CRWMS M&O, Nevada Local Procedure (NLP-3.34), MDGS Interface Control Documentation, Revision 1, August 13, 1998.*
2. *Strickler, R.L., 1998. Interim Direction for Document Development, Memo to D. R. Wilkins, J. N. Bailey and C. A. Heath, dated July 2, 1998.*
3. *Hayes, L.R., 1998, NEPO guidance on Implementing the "Interim Direction for Document Development."*

7.0 LIST OF ATTACHMENTS

Attachment 1: Personnel Contacted During the Audit
Attachment 2: Summary Table of Audit Results
Attachment 3 Summary Table of Audit Program Results

ATTACHMENT 1

Personnel Contacted During the Audit

<u>Name</u>	<u>Organization/Title</u>	<u>Pre-audit Meeting</u>	<u>Contacted During Audit</u>	<u>Post-audit Meeting</u>
Cleoves Martinez	LANL Technical Assurance Manager	X	X	X
Paul W. Reimus	LANL Principal Investigator	X	X	X
Valerie V. Whitlock	LANL Software Specialist	X		
John C. Friend	OQA Representative (LANL)	X	X	X
James E. Young	LANL Data Coordinator	X	X	X
Beth Gray	LANL Records/Document Control Coordinator	X	X	X
Dan Stone	LANL Tech. Data Specialist	X		X
Chuck Harrington	LANL Project YMP Leader	X		
Marc J. Haga	LANL Associate Investigator		X	
Diane Hier	TSM Contractor		X	
Tom Hiron	LANL YMP Laboratory Lead		X	
Mike Staples	LANL Project Planner and Scheduler		X	

ATTACHMENT 2

SUMMARY TABLE OF AUDIT RESULTS

Product	Critical Process Steps	Details (Checklist) -01 and (02 noted)	Deficiencies	REC	Process Effective -ness	Product Adequacy	Overall
Milestone SP32E2M4SZ	Scientific Investigation Planning	Pgs. 1 & 1	LVMO-98-D-027	3, 4, 6 & 7	MARGIN -AL	SAT	MARGIN -AL
	Identification, Traceability and Control of Data	Pgs. 4, 5, & 16		4	SAT	SAT	SAT
	Data Analysis, Review and Interpretation	Pgs. 1, 3, & 6 thru 19	LANL-99-D-007	5	UNSAT	SAT	SAT
	Control of Software	Pgs. 1, 3, 7, 8 & 19	LANL-99-D-006	7	UNSAT	SAT	UNSAT
	Model Development Code, Validation, Calibration and Output Reporting	CKL-02, 4		2	SAT	SAT	SAT
	Independent Review of Study Results	CKL-02, 4			SAT	SAT	SAT
	Data Input to GENESIS	2 CKL-02, 5		1	SAT	SAT	SAT
	Identification of Cites/References to TIC	CKL-02, 9			SAT	SAT	SAT

LEGEND:

SAT.....Satisfactory
UNSAT.....Unsatisfactory

ATTACHMENT 3

SUMMARY TABLE OF AUDIT PROGRAM RESULTS

QARD Element	Implementing Document	Details (Checklist)	Deficiency Reports	CDA	REC	Program Adequacy	Procedure Compliance	Overall
2.0	LANL-YMP-QP-02.5 QP-02.7 QP-03.23	Pg. 2 Pg. 3 Pgs. 1, 2, 6, 7	LVMO-98-D-027		3, 6 & 7	SAT	SAT	SAT
12.0	LANL-YMP-QP-12.3	Pg. 9				SAT	SAT	SAT
17.0	LANL-YMP-QP 17.1Q	Pg. 5		CDA		SAT	SAT	SAT
S-I	LANL-YMP-QP-03.20 QP-03.21	Pgs. 7, 8 Pgs. 7, 8 CKL-01, 19	LANL-99-D-006			SAT	UNSAT	UNSAT
S-II	LANL-YMP-QP-08.1 QP-08.3	Pgs. 4 & 5 Pg. 5	LANL-99-D-007			SAT	UNSAT	UNSAT
S-III	LANL-YMP-QP-03.5 QP-03.23	Pgs. 4, 6, 7 Pg. 4				SAT	SAT	SAT